

**What Is Claimed Is:**

- 1           1.       A method for detecting violations of type rules in a computer  
2 program, comprising:  
3           receiving the computer program;  
4           locating a type casting operation within the computer program, wherein  
5 the type casting operation involves a first pointer and a second pointer;  
6           checking the type casting operation for a violation of a type rule; and  
7           if a violation is detected, indicating the violation.
- 1           2.       The method of claim 1, wherein checking the type casting  
2 operation involves determining if the first pointer is defined to be a structure  
3 pointer and the second pointer is not defined to be a structure pointer, and if so,  
4 indicating a violation if no char exception applies.
- 1           3.       The method of claim 2, wherein indicating the violation involves:  
2           generating a warning to warn a programmer of a potential type violation if  
3 the second pointer is a void or char pointer; and  
4           generating an error to indicate a type violation to the programmer if the  
5 second pointer is a pointer to a scalar.
- 1           4.       The method of claim 1, wherein if the first pointer is defined to  
2 point to a first structure type and the second pointer is defined to point to a second  
3 structure type, the method further comprises:  
4           determining whether the first structure type and the second structure type  
5 belong to the same alias group; and

6 if the first structure type and the second structure type do not belong to the  
7 same alias group, generating an error to indicate a type violation.

1 5. The method of claim 4, wherein determining whether the first  
2 structure type and the second structure type belong to the same alias group  
3 involves:  
4 keeping track of special program statements that link structure types into  
5 alias groups;  
6 determining that the first structure type and the second structure type  
7 belong to the same alias group if the first structure type and the second structure  
8 type are the same structure type, or if one or more special procedures link the first  
9 structure type and the second structure type into the same alias group.

1 6. The method of claim 5, further comprising determining that the  
2 first structure type and the second structure type belong to the same alias group if  
3 the first structure type and the second structure type have all the same basic types  
4 in the same order.

1 7. The method of claim 1, wherein the computer program is received  
2 in source code form, and wherein the method further comprises parsing the  
3 computer program into an intermediate form prior to locating the type casting  
4 operation.

1 8. The method of claim 1, further comprising:  
2 receiving an identifier for a set of constraints on memory references that a  
3 programmer has adhered to in writing the computer program; and

1           using the identifier to select a type casting rule from a set of type casting  
2 rules, the selected type casting rule being associated with the set of constraints;  
3           wherein each type casting rule in the set of type casting rules is associated  
4 with a different set of constraints on memory references.

1           9.       The method of claim 1, wherein the method is performed by a  
2 compiler.

1           10.     The method of claim 1, wherein the method is performed by an  
2 error checking application, which is not part of a compiler.

1           11.     A computer-readable storage medium storing instructions that  
2 when executed by a computer cause the computer to perform a method for  
3 detecting violations of type rules in a computer program, the method comprising:  
4           receiving the computer program;  
5           locating a type casting operation within the computer program, wherein  
6 the type casting operation involves a first pointer and a second pointer;  
7           checking the type casting operation for a violation of a type rule; and  
8           if a violation is detected, indicating the violation.

1           12.     The computer-readable storage medium of claim 11, wherein  
2 checking the type casting operation involves determining if the first pointer is  
3 defined to be a structure pointer and the second pointer is not defined to be a  
4 structure pointer, and if so, indicating a violation if no char exception applies.

1           13.     The computer-readable storage medium of claim 12, wherein  
2 indicating the violation involves:

3           generating a warning to warn a programmer of a potential type violation if  
4   the second pointer is a void or char pointer; and  
5           generating an error to indicate a type violation to the programmer if the  
6   second pointer is a pointer to a scalar.

1           14.    The computer-readable storage medium of claim 11, wherein if the  
2   first pointer is defined to point to a first structure type and the second pointer is  
3   defined to point to a second structure type, the method further comprises:  
4           determining whether the first structure type and the second structure type  
5   belong to the same alias group; and  
6           if the first structure type and the second structure type do not belong to the  
7   same alias group, generating an error to indicate a type violation.

1           15.    The computer-readable storage medium of claim 14, wherein  
2   determining whether the first structure type and the second structure type belong  
3   to the same alias group involves:  
4           keeping track of special program statements that link structure types into  
5   alias groups;  
6           determining that the first structure type and the second structure type  
7   belong to the same alias group if the first structure type and the second structure  
8   type are the same structure type, or if one or more special procedures link the first  
9   structure type and the second structure type into the same alias group.

1           16.    The computer-readable storage medium of claim 15, wherein the  
2   method further comprises determining that the first structure type and the second  
3   structure type belong to the same alias group if the first structure type and the  
4   second structure type have all the same basic types in the same order.

1           17.     The computer-readable storage medium of claim 11, wherein the  
2 computer program is received in source code form, and wherein the method  
3 further comprises parsing the computer program into an intermediate form prior to  
4 locating the type casting operation.

1           18.     The computer-readable storage medium of claim 11, wherein the  
2 method further comprises:  
3           receiving an identifier for a set of constraints on memory references that a  
4 programmer has adhered to in writing the computer program; and  
5           using the identifier to select a type casting rule from a set of type casting  
6 rules, the selected type casting rule being associated with the set of constraints;  
7           wherein each type casting rule in the set of type casting rules is associated  
8 with a different set of constraints on memory references.

1           19.     The computer-readable storage medium of claim 11, wherein the  
2 method is performed by a compiler.

1           20.     The computer-readable storage medium of claim 11, wherein the  
2 method is performed by an error checking application, which is not part of a  
3 compiler.

1           21.     An apparatus that detects violations of type rules in a computer  
2 program, comprising:  
3           a receiving mechanism that is configured to receive the computer program;

4 a locating mechanism that is configured to locate a type casting operation  
5 within the computer program, wherein the type casting operation involves a first  
6 pointer and a second pointer; and  
7 a type rule checking mechanism that is configured check the type casting  
8 operation for a violation of a type rule, and if a violation is detected, to indicate  
9 the violation.

1 22. The apparatus of claim 1, wherein the type rule checking  
2 mechanism is configured to determine if the first pointer is defined to be a  
3 structure pointer and the second pointer is not defined to be a structure pointer,  
4 and if so, to indicate a violation if no char exception applies.

1 23. The apparatus of claim 22, wherein the type rule checking  
2 mechanism is configured to:  
3 generate a warning to warn a programmer of a potential type violation if  
4 the second pointer is a void or char pointer; and to  
5 generate an error to indicate a type violation to the programmer if the  
6 second pointer is a pointer to a scalar.

1 24. The apparatus of claim 21, wherein if the first pointer is defined to  
2 point to a first structure type and the second pointer is defined to point to a second  
3 structure type, the type rule checking mechanism is configured to:  
4 determine whether the first structure type and the second structure type  
5 belong to the same alias group; and to  
6 generate an error to indicate a type violation if the first structure type and  
7 the second structure type do not belong to the same alias group.

1           25.    The apparatus of claim 24, wherein in determining whether the  
2 first structure type and the second structure type belong to the same alias group,  
3 the type rule checking mechanism is configured:  
4           keep track of special program statements that link structure types into alias  
5 groups; and to  
6           determine that the first structure type and the second structure type belong  
7 to the same alias group if the first structure type and the second structure type are  
8 the same structure type, or if one or more special procedures link the first structure  
9 type and the second structure type into the same alias group.

1           26.    The apparatus of claim 25, wherein the type rule checking  
2 mechanism is configured to determine that the first structure type and the second  
3 structure type belong to the same alias group if the first structure type and the  
4 second structure type have all the same basic types in the same order.

1           27.    The apparatus of claim 21,  
2           wherein the receiving mechanism is configured to receive the computer  
3 program in source code form; and  
4           wherein the apparatus further comprises a parsing mechanism that is  
5 configured to parse the computer program into an intermediate form prior to  
6 locating the type casting operation.

1           28.    The apparatus of claim 21, wherein the receiving mechanism is  
2 configured to receive an identifier for a set of constraints on memory references  
3 that a programmer has adhered to in writing the computer program, and further  
4 comprising:

1 a selection mechanism that is configured to use the identifier to select a  
2 type casting rule from a set of type casting rules, the selected type casting rule  
3 being associated with the set of constraints;  
4 wherein each type casting rule in the set of type casting rules is associated  
5 with a different set of constraints on memory references.

1 29. The apparatus of claim 21, further comprising a compiler that  
2 contains the receiving mechanism, the locating mechanism and the type rule  
3 checking mechanism.

1 30. The apparatus of claim 21, further comprising an error checking  
2 application, which is not part of a compiler;  
3 wherein the error checking application contains the receiving mechanism,  
4 the locating mechanism and the type rule checking mechanism.